Sustainable Urban Development Workshop

Climate Change at the Regional Level

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- Thirty years of research and and an international effort has documented global climate change and the forcings that are affected by human activity. The focus now is on regional climate change - the scale at which climate change will be experienced and decisions in response to climate change will be made.
- Sustainable urban development is dependent on access to information on climate change and a collaborative relationship between decision makers and the science community.

Climate Change at the Regional Level

What do we mean by climate change?

- Long term changes in temperature and precipitation regimes.
- Environmental changes in the atmosphere, on land and in the water that impact life on earth.

Climate Change at the Regional Level

What can we do about climate change; how do we respond to it?

- Predict
  - Future condition of temperature/precipitation regimes and environment
- Mitigate
  - Actions to modify, slow or reverse climate change forcings
- Adapt
  - Actions to sustain life under new climate regimes

Climate Change at the Regional Level

What is NASA doing about climate change?

- Research
  - An Earth science program to address climate change research questions.
  - Focused on the continental to global scale.
- Applications
  - An applications program to use Earth science data, technology, and modeling to support decision making for social and economic benefit.
  - Focused on the regional to national scale

NASA Earth Science Questions:

How is the global earth system changing?

What are the primary forcings of the earth system?

How does the earth system respond to natural and human-induced changes?

What are the consequences of change in the earth system to human civilization?

How will the earth system change in the future?

IPCC Climate Regions

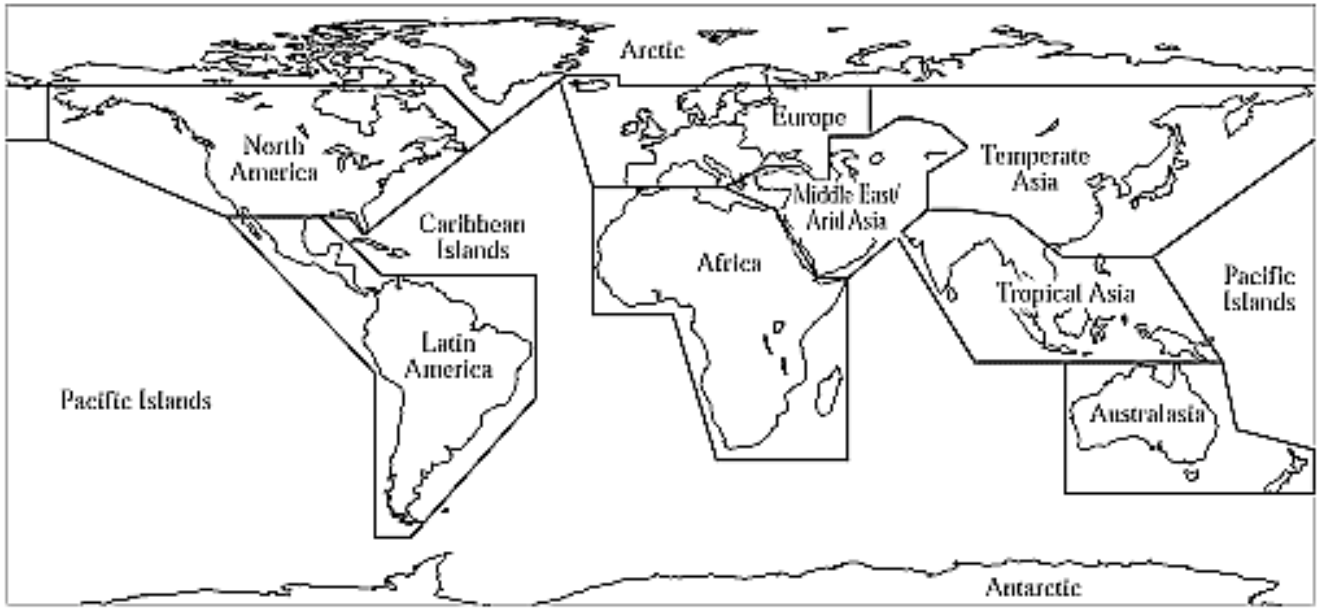
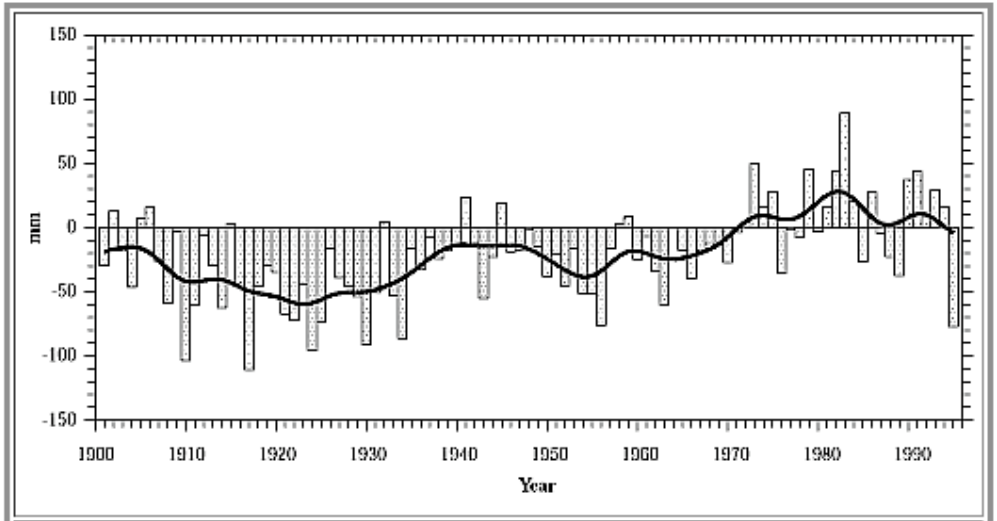


Figure A-3: GIS mask used to define the 10 regions covered in this Special Report.

IPCC Climate Data for N. America



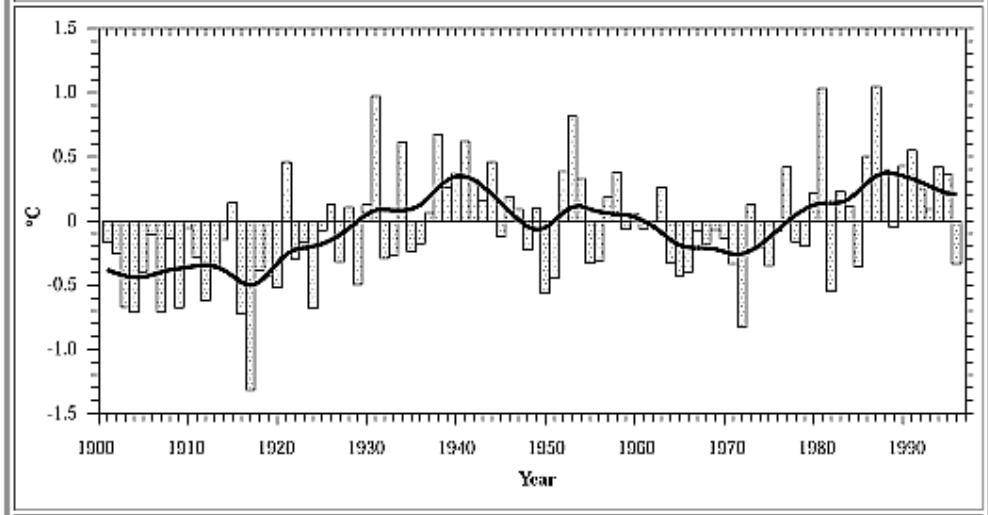
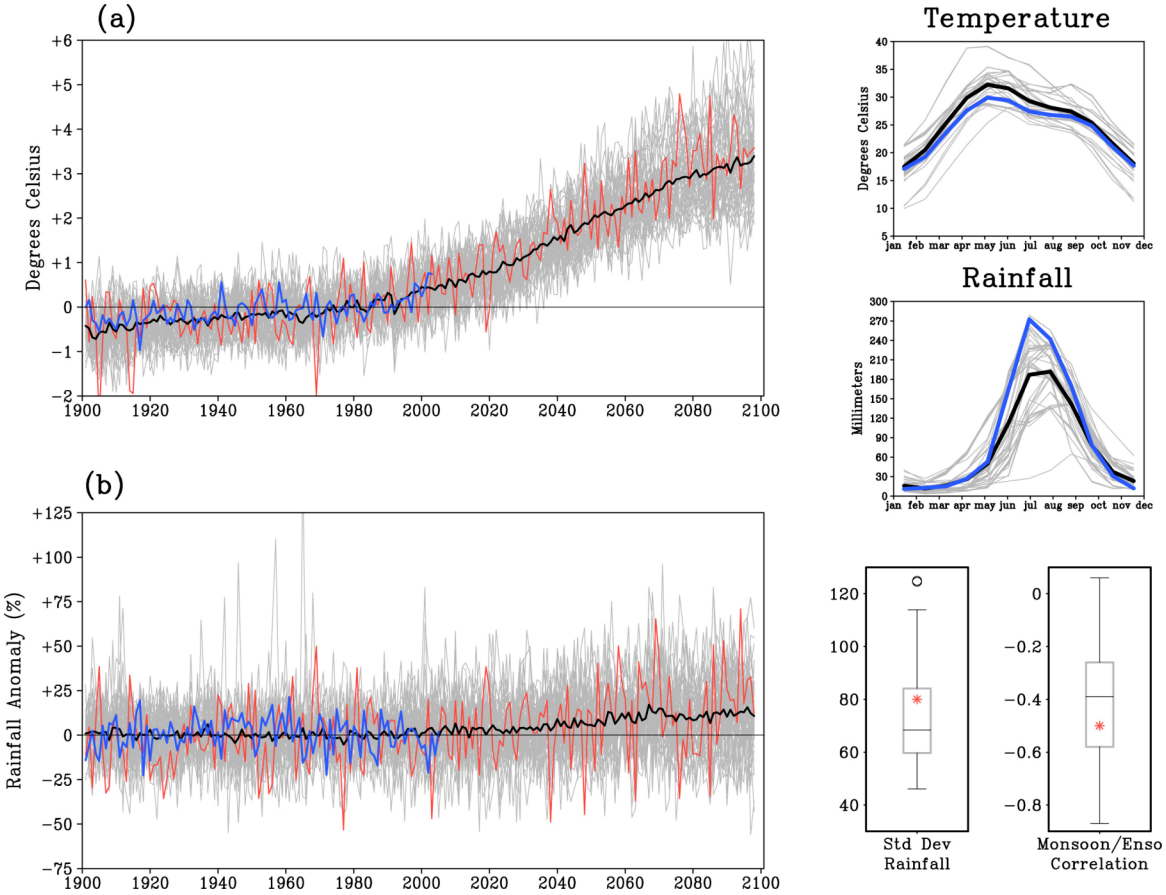


Figure A-10: Observed annual precipitation (top) and temperature (bottom) changes for the North America region.

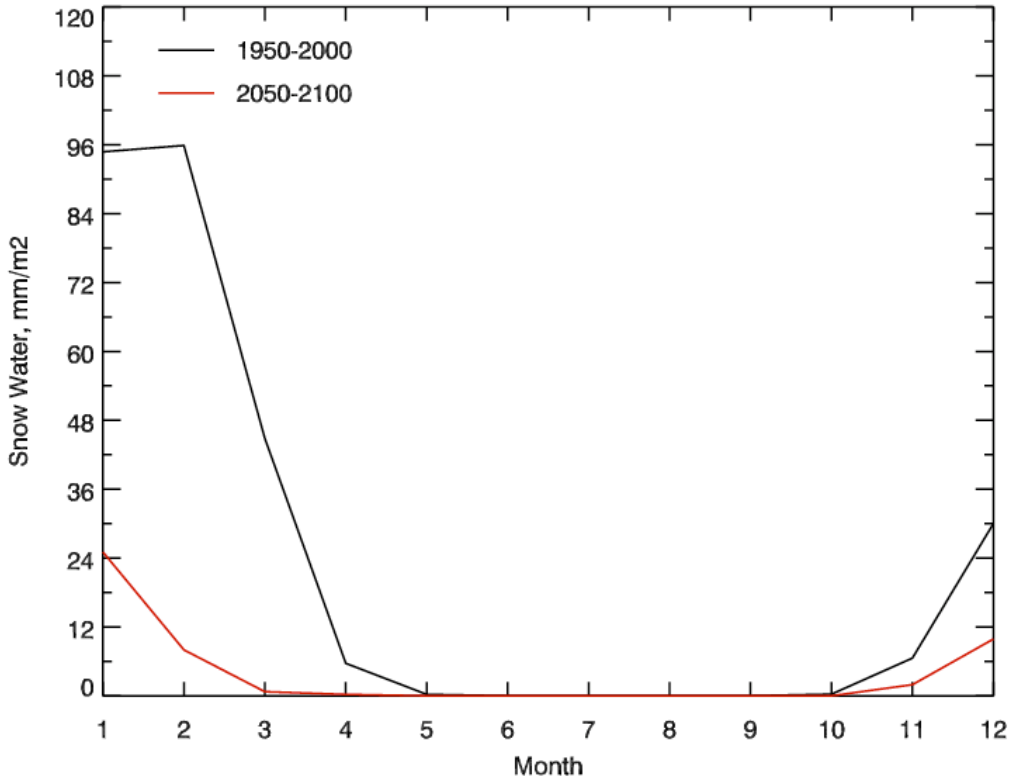
The once and future pulse of Asian Monsoon



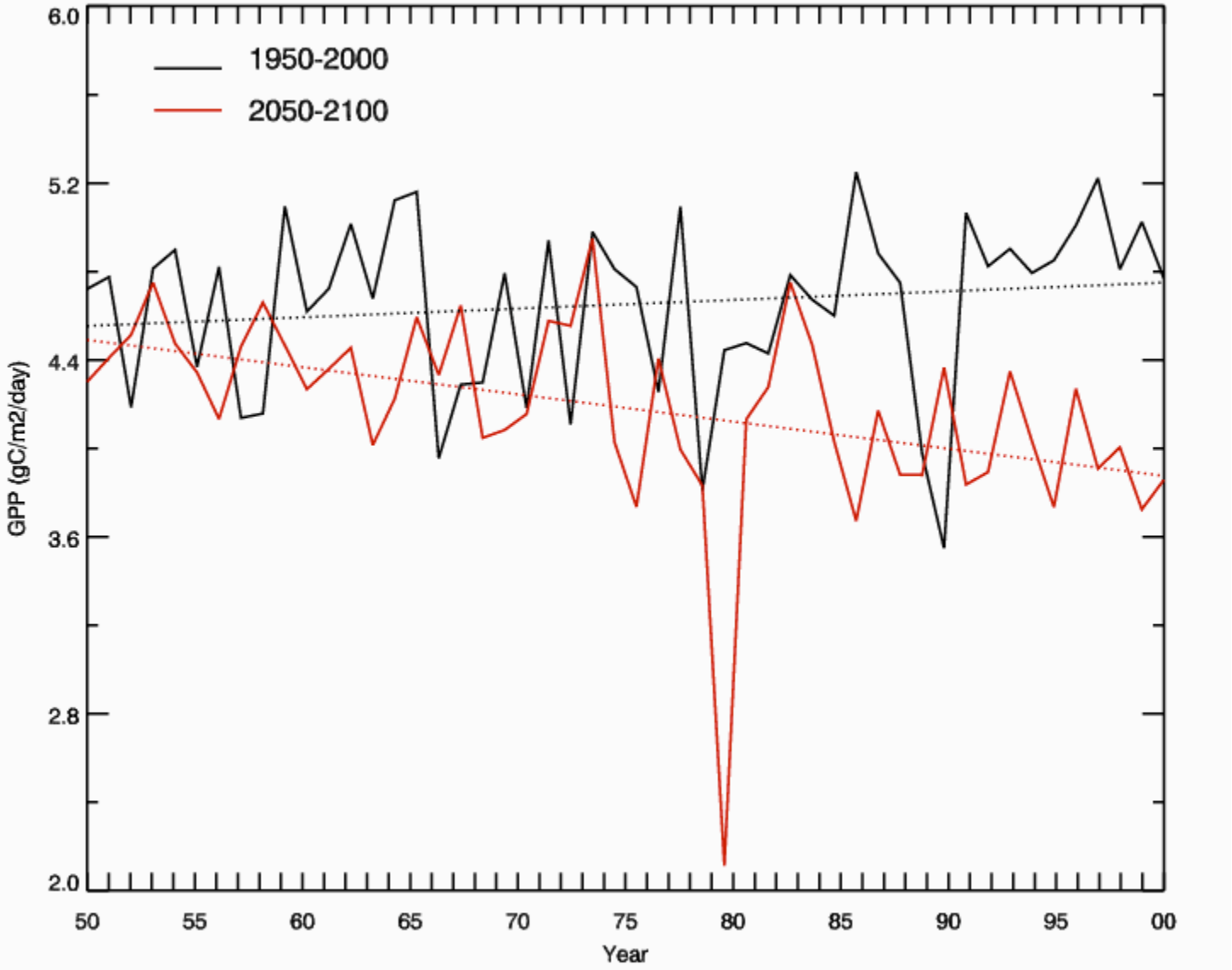
IPCC-AR4 simulations for the 1901-2098 period - a) Annual surface temperature over India and (b) Monsoon rainfall over India. The grey lines indicate the ensembles, the black line is the ensemble mean, the blue line is the observed. The red line is the ensemble member corresponding to the Hadley Center coupled model. The right hand figures show the annual cycle of temperature and rainfall over India and, boxplots of standard deviation and monsoon-ENSO correlation, for the observational (1901-2000) period. The observed values are shown as red points in the boxplots.

Krishnakumar et al., PNAS, 2008

Impact of projected warming on Yosemite snow dynamics

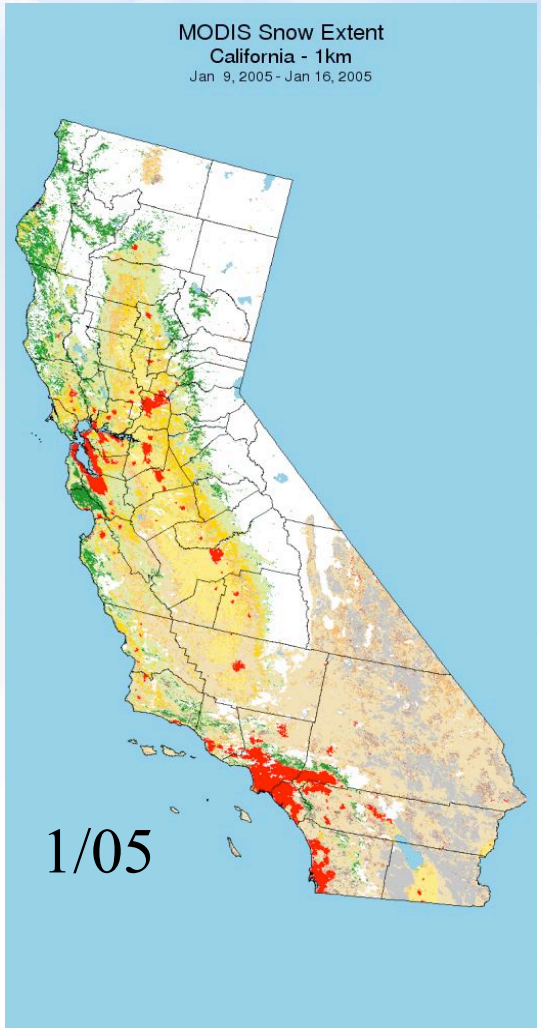


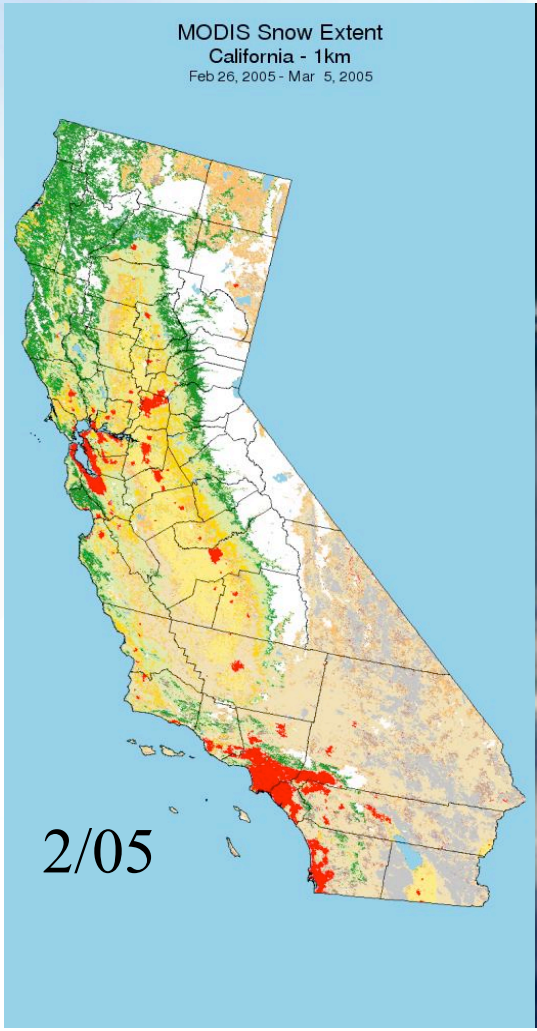
Projected trends in vegetation productivity



Yosemite National Park

Satellite data





Daily Weather Surfaces 1KM

Raw data

Gridded Products

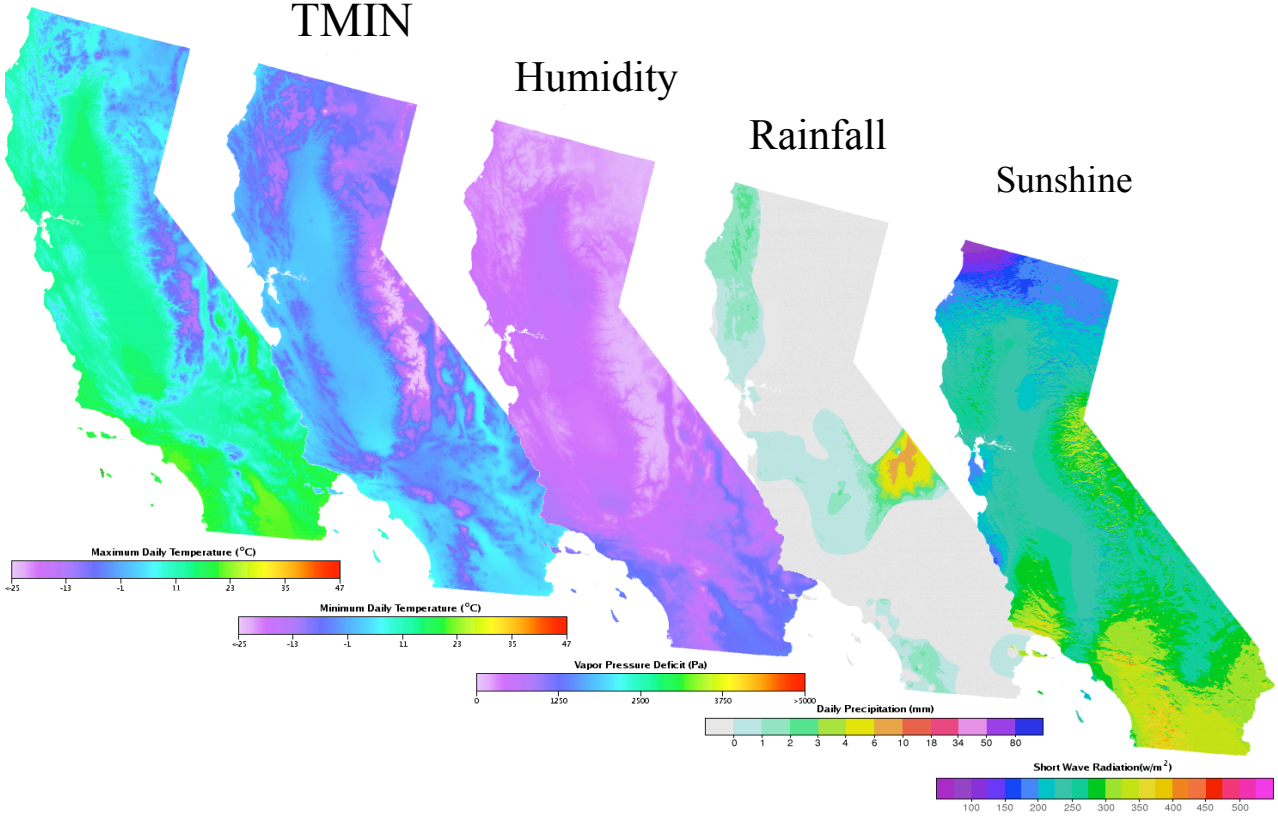
TMAX

TMIN

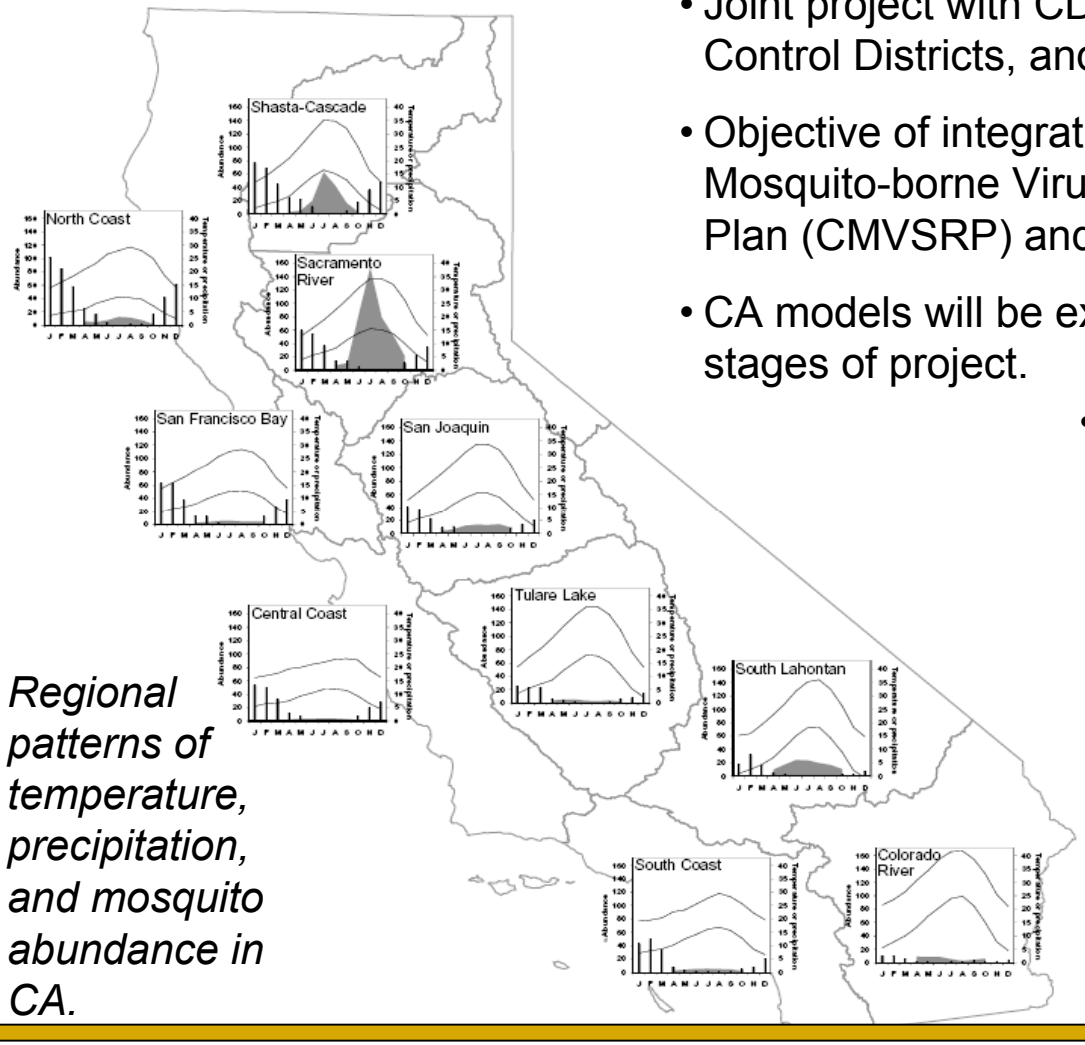
Humidity

Rainfall

Sunshine



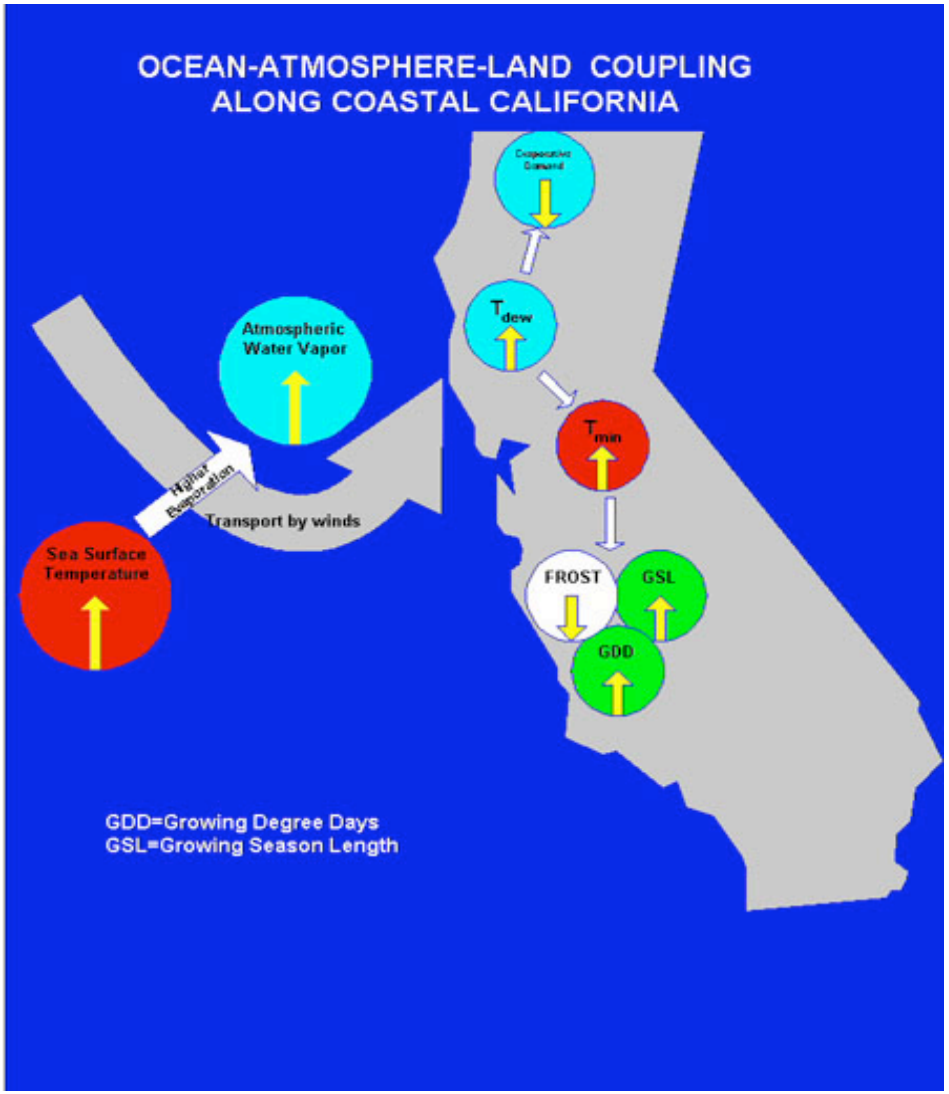
Public Health Applications for CDC: Forecasting Mosquito Abundance and WNV Transmission Risk

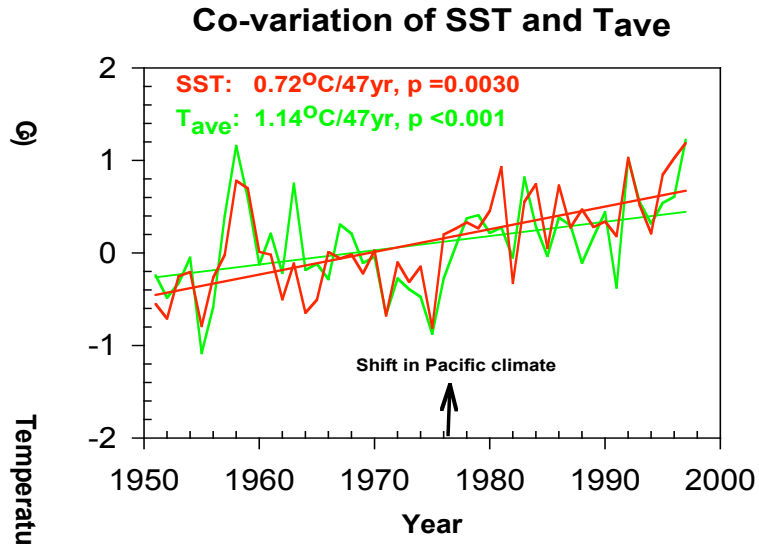


Regional patterns of temperature, precipitation, and mosquito abundance in CA.

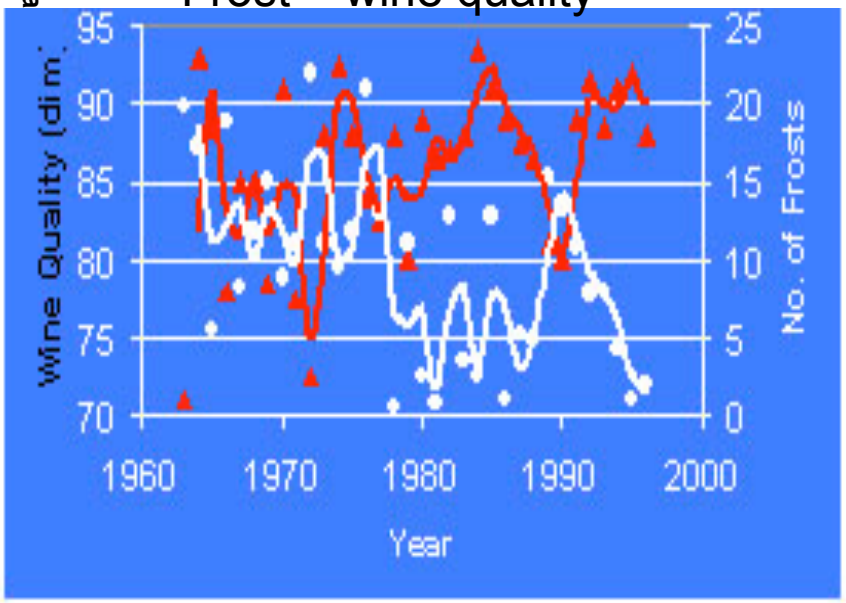
- Joint project with CDC, UC Davis, and CA Vector Control Districts, and CA Dept. of Health Services
- Objective of integrating TOPS data into the California Mosquito-borne Virus Surveillance and Response Plan (CMVSRP) and the CDC Arbonet system
- CA models will be extended to western U.S. in later stages of project.
- Work to date has shown temperature, precipitation, and snow melt patterns are major drivers. First stage of risk modeling is focused on these TOPS parameters. Second stage will incorporate phenology and soil moisture (influences of these factors are moderated by land use, especially irrigation).

Strong maritime influence creates ideal wine producing climate





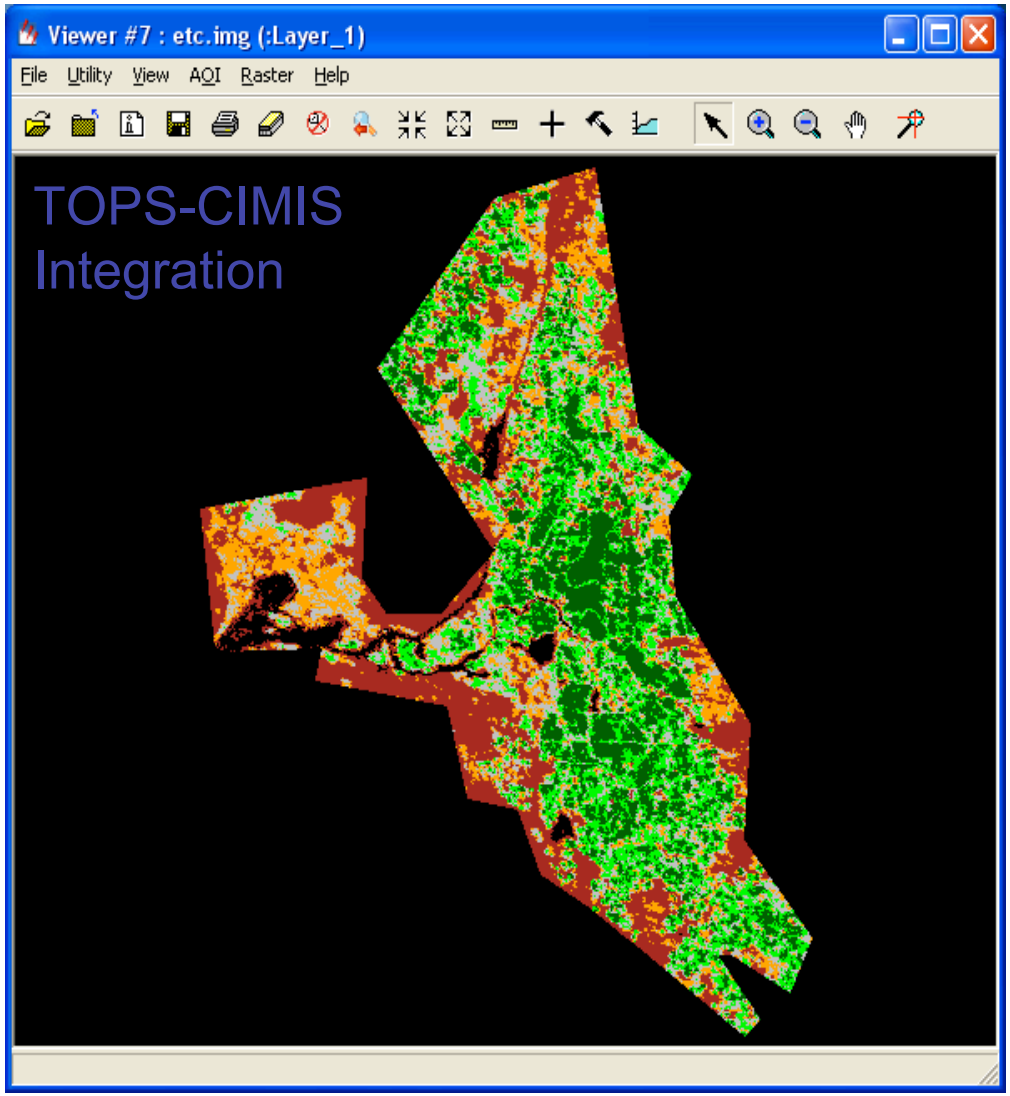
Frost – wine quality



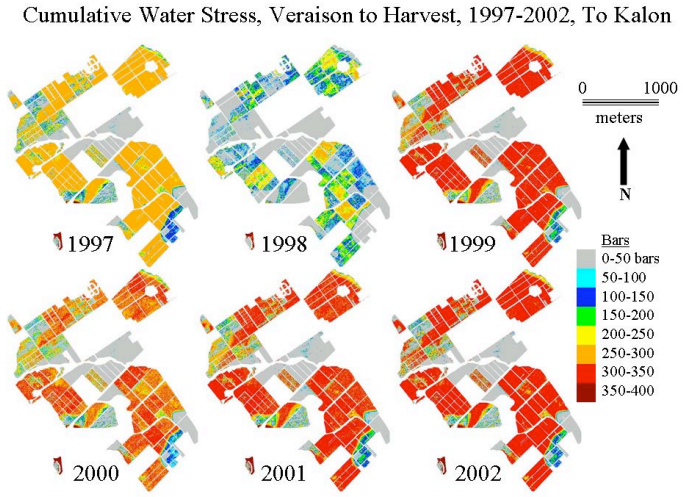
interannual

Nemani et al., 2001 Climate Research, 19: 25-34

Irrigation Management with TOPS

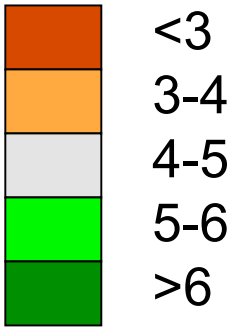


(California Irrigation Management Information System)



By integrating spatially continuous satellite data with CIMIS data at various locations, we can provide farm-level Irrigation requirements.

Daily ETc (mm)



DWR/Lee Johnson

Regional/Local Solutions

NASA has demonstrated, on a project by project basis, the tools for evaluation of climate change, i.e., prediction of environmental change and information essential to support resource management and policy decisions, at the regional level. What is missing is an organizational structure for ongoing interaction between decision makers and the science community. NASA should be part of that structure.

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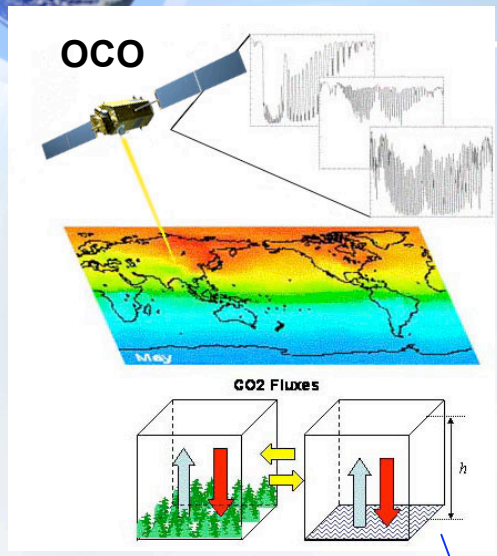
Carbon Accounting and Carbon Flux from Terrestrial Ecosystems

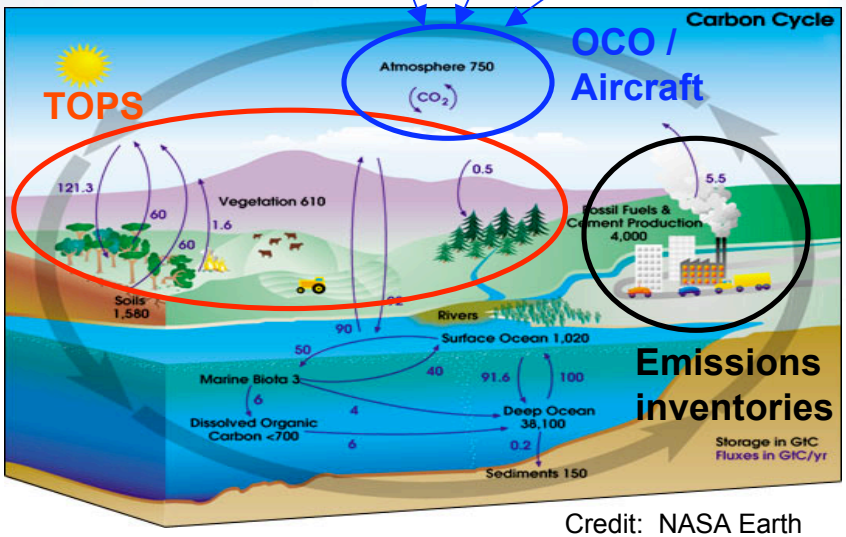


Credit: JPL

Alpha Jet

Credit: Adrian Pingstone

Altair



Credit: NASA Earth Science Enterprise

- Using measurements of atmospheric CO_2 concentrations from OCO, the NASA Altair UAV, or the Alpha jet, we can estimate local anthropogenic emissions by subtracting TOPS' estimated fluxes from natural ecosystems
- Estimates can be used to validate emissions inventories and identify unreported emission sources

Climate Change at the Regional Level

Questions for this presentation

- What do we mean by climate change?
- What can we do about climate change; how do we respond to it?
- What is NASA doing about climate change?
- How can NASA scientists and technicians, urban planners, and the commercial sector collaborate on climate change issues?

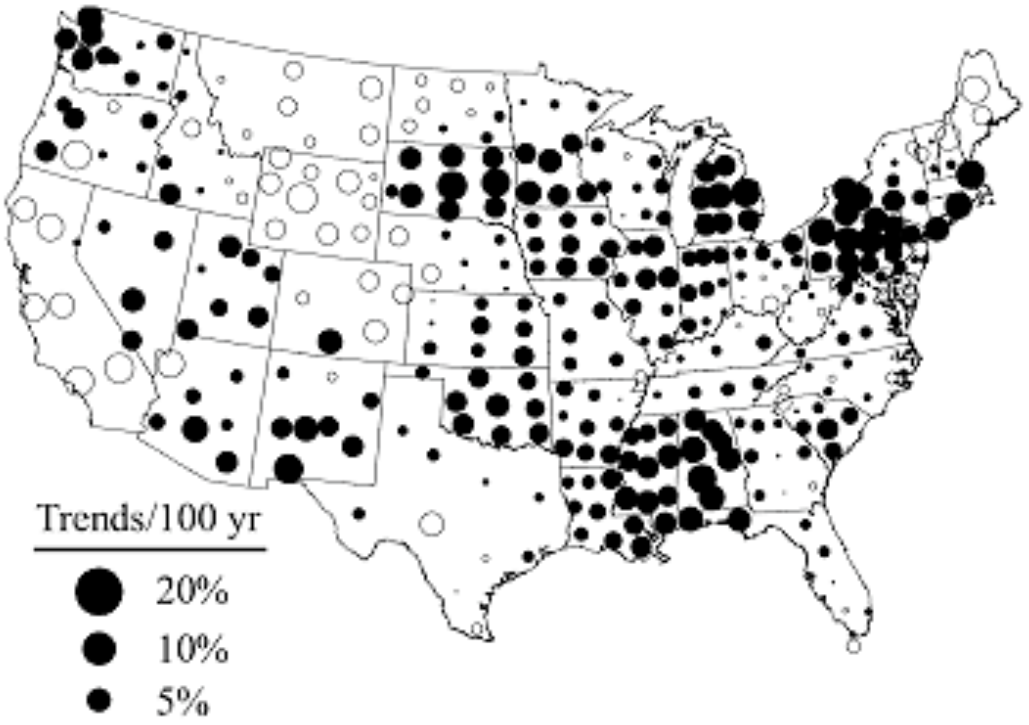
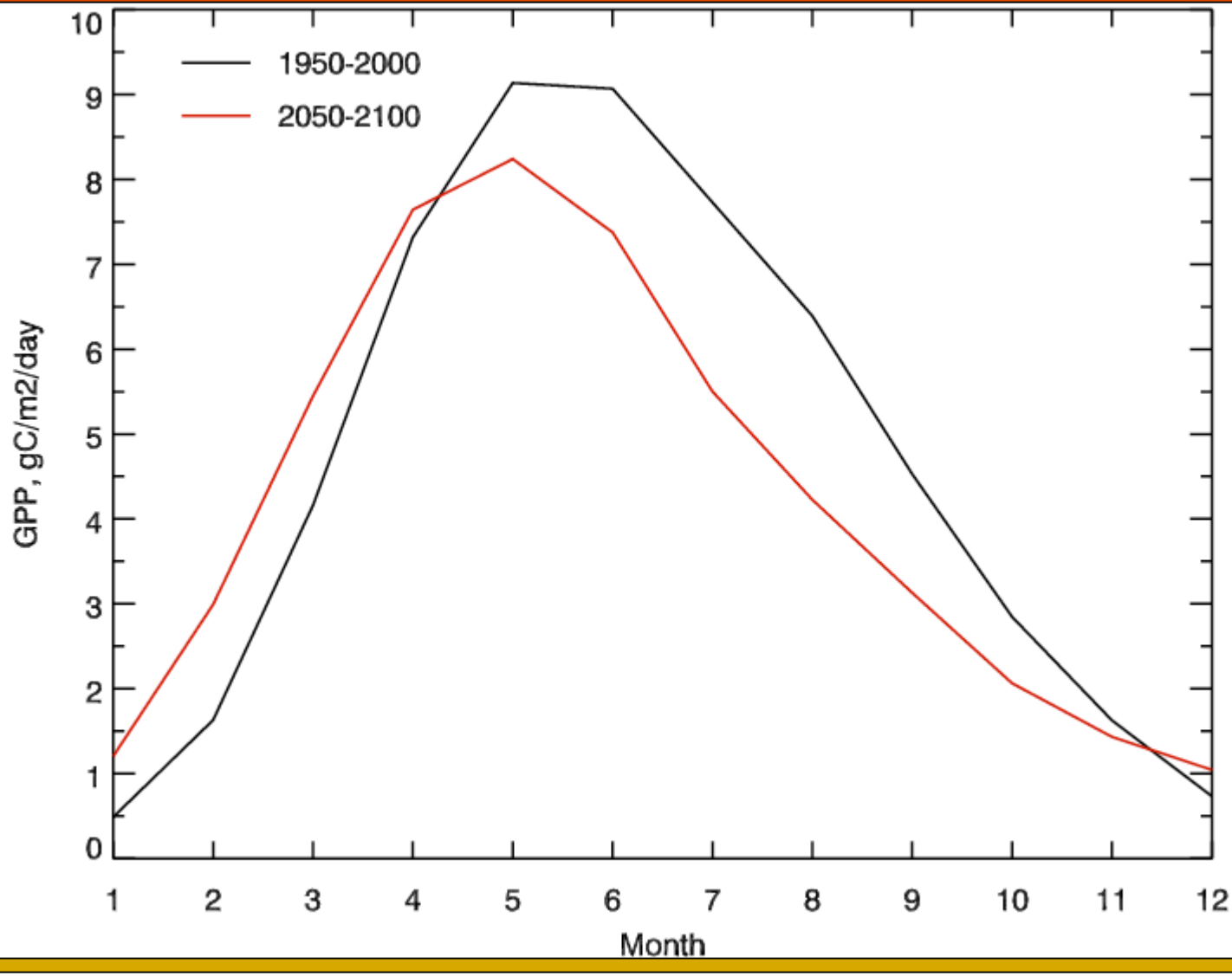


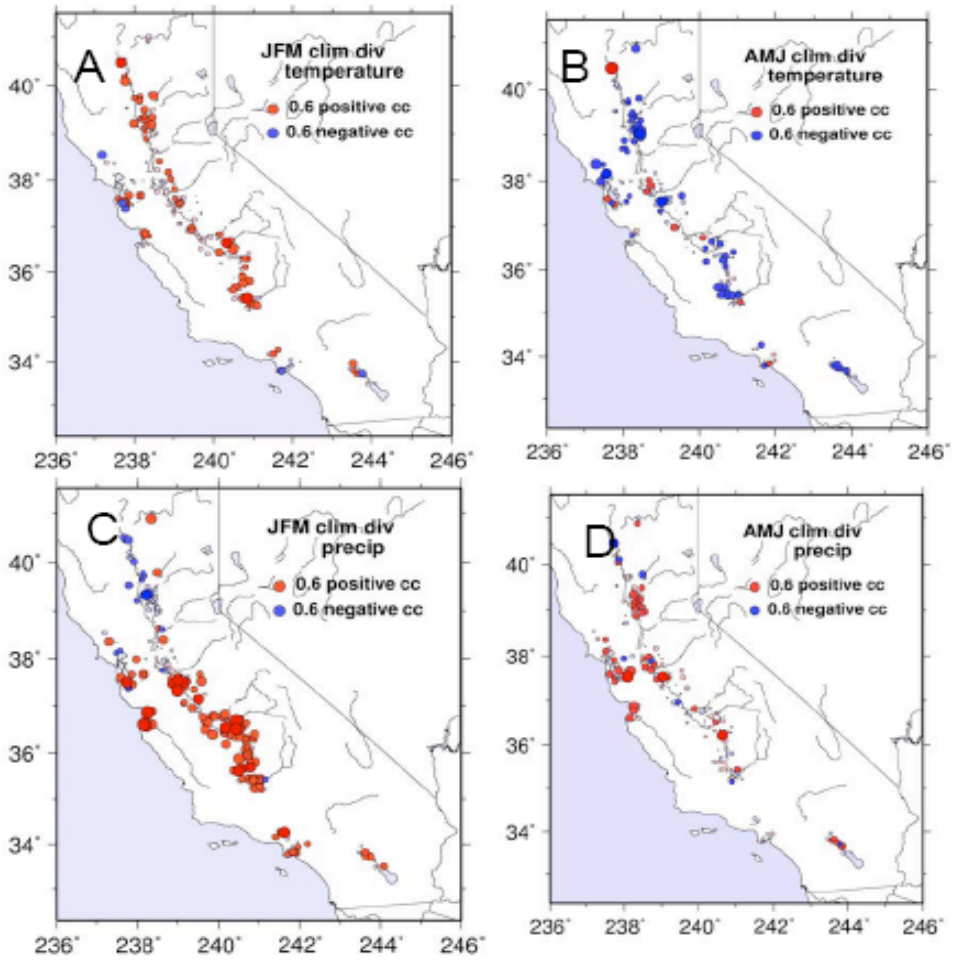
Figure 8-5: Conterminous U.S. precipitation trends for 1900-94 (converted to %/century), centered within state climatic divisions. The trend magnitude for each climatic division is reflected by the diameter of the circle. Solid circles represent increases, and open circles decreases.

Growing season dynamics under climate change



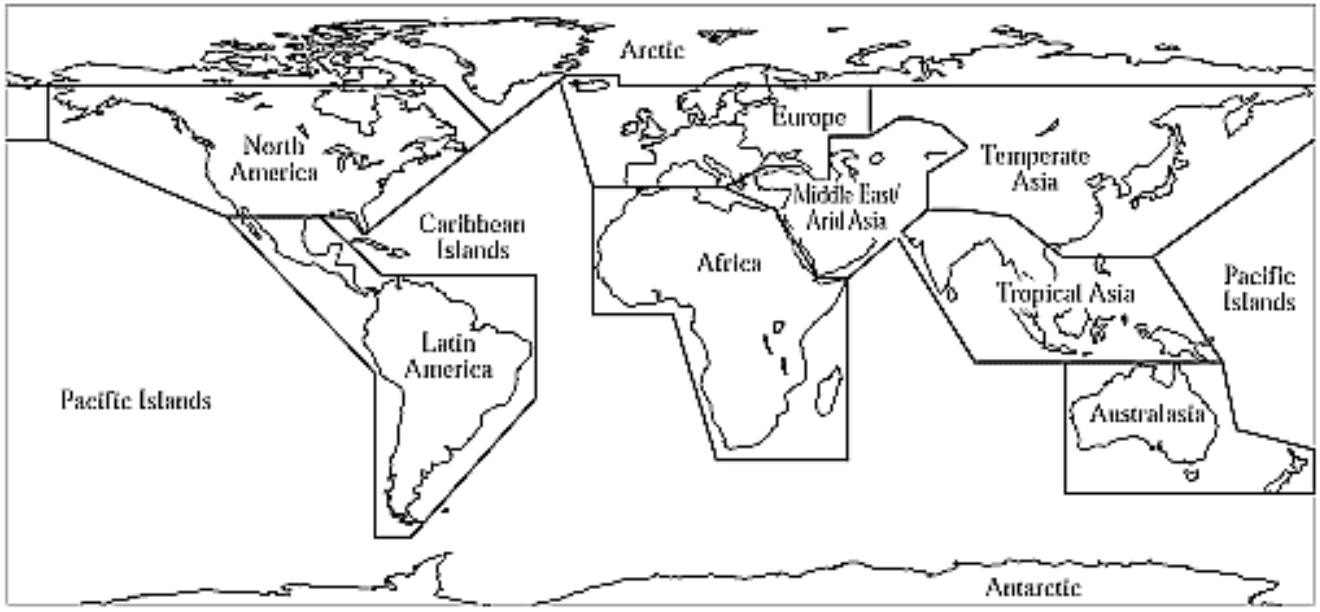
Yosemite National Park

Using TOPS Data to Identify Drivers of Mosquito Abundance and Virus Transmission Risk in California and western U.S.



Correlations between temperatures and mosquito abundance in CA

These relationships are being used to develop predictive models.



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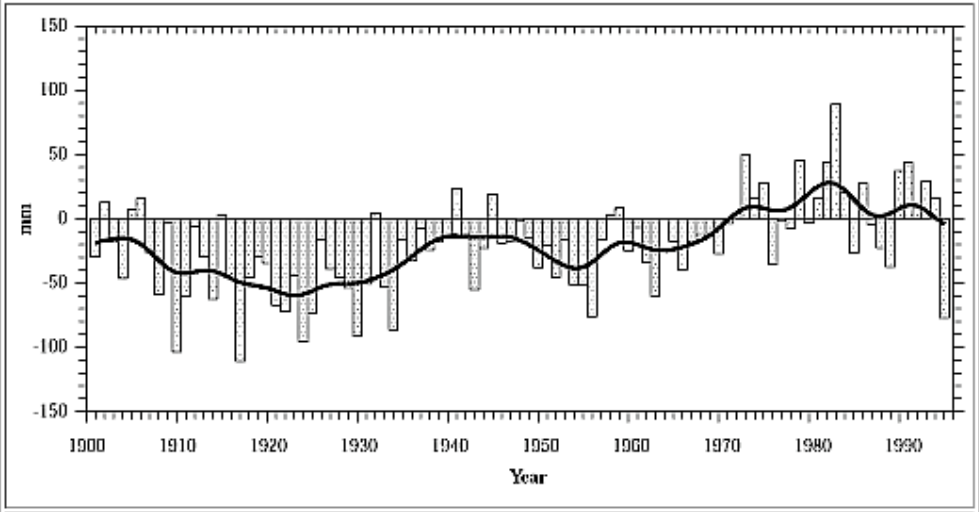

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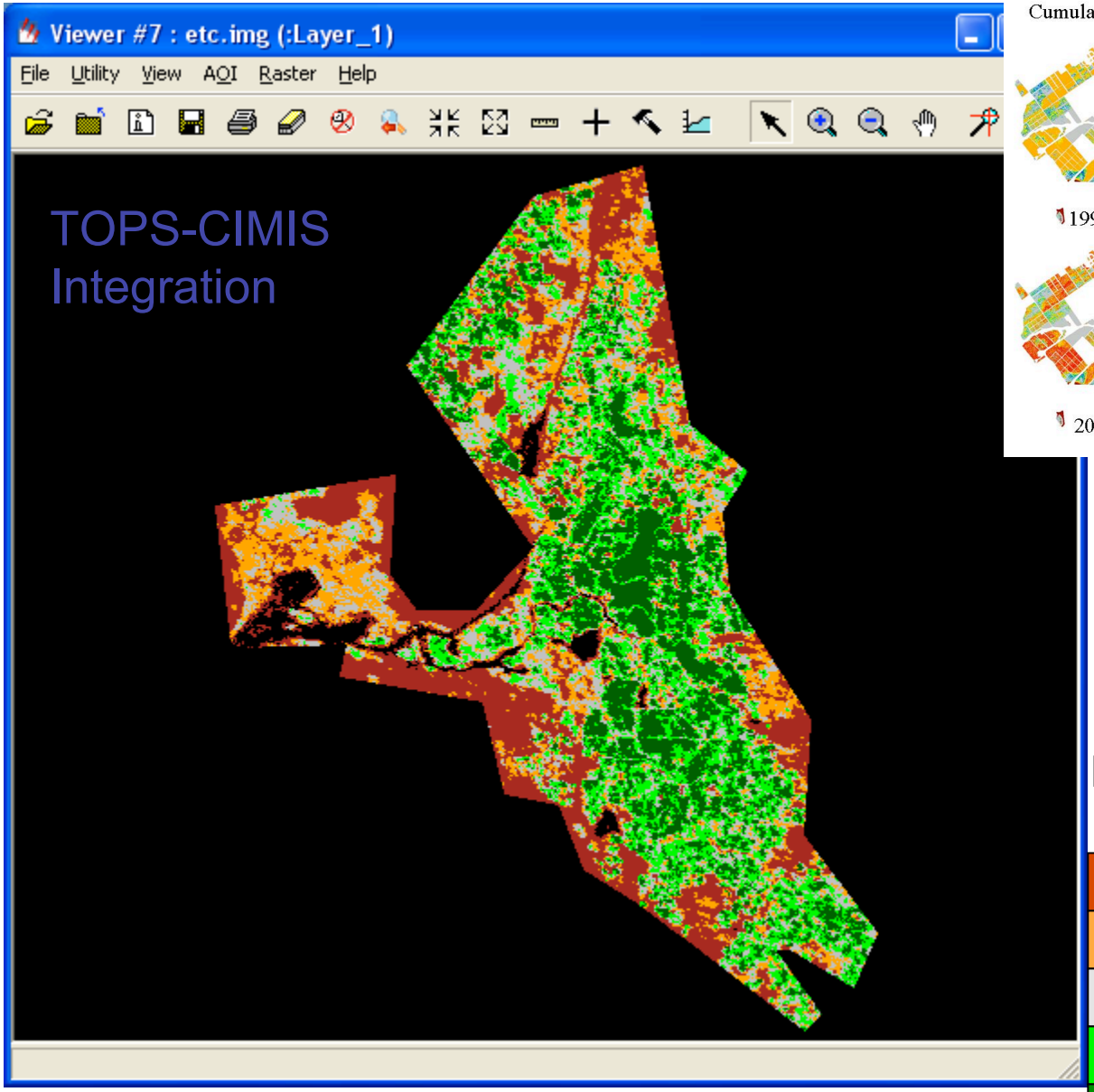
Irrigation Management with TOPS



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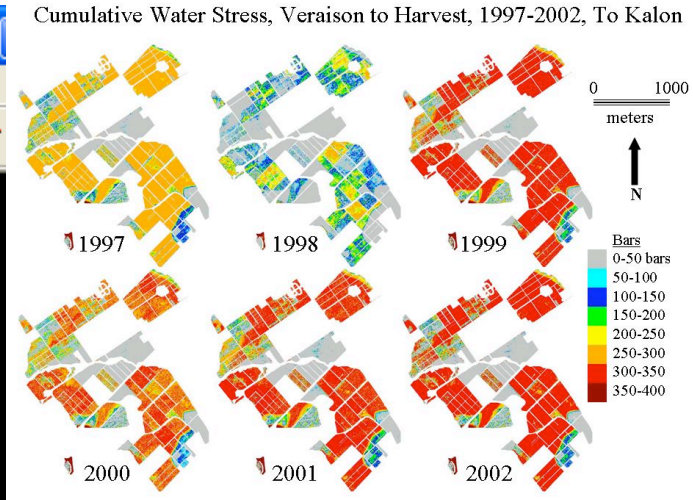

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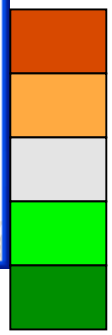

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DWR/Lee Johnson